

**Remarks**

Claims 81-90, 104, 105, 111 and 112 are pending in the Application.

Claims 81-87, 104, 105, 111 and 112 are rejected.

Claims 88-90 are objected to.

**I. REJECTIONS UNDER 35 U.S.C. § 102(a)/ § 103(a) OVER TOHJI**

Examiner has rejected Claims 81-87 under 35 U.S.C. § 102(a) as being anticipated by or in the alternative, under 35 U.S.C. § 103(a) as obvious over Tohji et al., *Nature*, (“*Tohji*”). Office Action at 2. Applicant traverses these rejections.

**A. Anticipation**

Anticipation requires each and every element of the claim to be found within the cited prior art reference. Examiner apparently contends that *Tohji* discloses all of the elements of the claims because the *Tohji* “reference teaches SWNTs of the claimed length” and that although *Tohji* “does not discuss the number of nanotubes, . . . they are made in bulk so it appears the claimed number are made.” Office Action at 2.

Claim 81 (as well as Claims 82-87, which depend either directly or indirectly from it) requires:

A macroscopic molecular array comprising at least about  $10^6$  single-wall carbon nanotubes in generally parallel orientation and having substantially similar lengths in the range of from about 5 to about 500 nanometers.

Thus, these claims require more than simply a particular number of nanotubes. They require a macroscopic molecular array having at least a specified number (about  $10^6$ ) of single-wall carbon nanotubes oriented in a particular manner (generally parallel) and having substantially similar lengths in a range of from about 5 to about 500 nanometers. *Tohji* fails to disclose such features.

Applicant respectfully points out that *Tohji* teaches only a method for purifying single-wall carbon nanotubes. No mention is made of molecular arrays of such nanotubes.

Furthermore, *Tohji* does not teach or suggest a macroscopic nanotube array of at least about  $10^6$  single-wall carbon nanotubes in generally parallel orientation; nor is there any teaching or suggestion in *Tohji* how such a number of single-wall carbon nanotubes could be arranged. Also, *Tohji* does not teach a nanotube length, *i.e.*, nothing in *Tohji* teaches, or suggests, a nanotube of any length, or any length in the range from about 5 to about 500 nanometers. *Tohji* also does not teach or suggest nanotubes of substantially similar lengths. As *Tohji* does not do so, *Tohji* does not teach or suggest nanotubes of substantially similar lengths.

Because these elements are not disclosed in or taught by *Tohji*, Claim 81 cannot be anticipated.

Regarding Claims 82-87, all of these claims are dependent upon Claim 81, and are not anticipated for the same reasons that Claim 81 is not anticipated by *Tohji*. In addition, Claims 82-86 involve types of nanotubes, which *Tohji* does not teach or suggest. Claim 86 also includes the element of a substrate attached to the end of the molecular array of single-wall carbon nanotubes wherein the substrate is oriented substantially perpendicularly to the nanotubes in said array. *Tohji* does not teach or suggest a nanotube array attached to substrate wherein the nanotubes are substantially perpendicular to the substrate.

Accordingly, Claims 82-87 are further not anticipated by *Tohji*. Therefore, as a result of the foregoing, Applicant respectfully requests that the Examiner withdraw his rejection of Claims 81-87 under 35 U.S.C. § 102(a) as being anticipated by *Tohji*.

#### **B. Obviousness**

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art and not based on applicant's

disclosure. See M.P.E.P. 706.02(j); see also *In re Vaeck*, 947 F.2d 488, 20 U.S.P.Q.2d 1438 (Fed. Cir. 1991).

Examiner has failed to show any of these three basic criteria and, thus, has failed to present a *prima facie* case of obviousness. Aware of these deficiencies of *Tohji*, the Examiner attempts to overlook them by citing *In re Rose* 220 F.2d 459, 105 U.S.P.Q. 237 (C.C.P.A. 1955) for the proposition that “the amount of a material does not impart patentability.” As binding case law and the M.P.E.P. reflect, this is a misstatement of the law, and the Examiner reliance on *In re Rose* to make these obviousness rejections is misguided.

The Federal Circuit and its predecessor court have long recognized that a claim, while not anticipated, can be held to be obvious when the *only* difference between the prior art and the claims was a recitation of relative dimension of the claimed invention *and* the invention having the claimed relative dimensions would not perform differently than the disclosure in the prior art reference. M.P.E.P. § 2144.04(IV)(A) (citing *In re Rose*, 220 F.2d 459, 105 U.S.P.Q. 237); See also *Gardner v. TEC Systems, Inc.*, 725 F.2d 1338, 1345, 220 U.S.P.Q. 777, 783 (Fed. Cir. 1984).

As noted above, there are differences between the prior art and the claims (Claim 81 and its dependent Claims 82-87) that go well beyond dimensional differences. These non-dimensional differences absent in *Tohji* are discussed above in Section I.A.

Furthermore, the resulting product, as claimed, has a plethora of properties and uses that the products disclosed and taught in *Tohji* do not have. These are discussed in detail throughout the Application, such as at 45-56. Thus, the claimed invention is not simply a scaling up in size or amount of the materials disclosed in *Tohji*. Rather, it is the creation of a new and non-obvious product. The non-obviousness of the claimed invention under the present circumstance is in complete accord with Federal Circuit and its predecessor court's long standing precedent, which reflects that when the size or amount of the invention leads to compositions that have unique and novel properties and use (and also when something is produced that theretofore had not been able to be accomplished), that such an invention was non-obvious and patentable. See *In re*

*Kirke*, 40 F.2d 765, 767, 5 U.S.P.Q. 539 (C.C.P.A. 1930);<sup>1</sup> *see also Gardner*, 725 F.2d at 1345, 220 U.S.P.Q. at 783.

Accordingly, Claims 82-87 are further not obvious in view of *Tohji*. Therefore, as a result of the foregoing, Applicant respectfully requests that the Examiner withdraw his rejection of Claims 81-87 under 35 U.S.C. § 103(a) as being obvious over *Tohji*.

## II. REJECTIONS UNDER 35 U.S.C. § 102(b)/ § 103(a) OVER AJAYAN

Examiner has rejected Claims 81-87 under 35 U.S.C. § 102(a) as being anticipated by or in the alternative, under 35 U.S.C. § 103(a) as obvious over Ajayan et al., *Science*, (“Ajayan”). Office Action at 2. Applicant traverses these rejections.

### A. Anticipation

Again, anticipation requires each and every element of the claim to be found within the cited prior art reference. Examiner raises the identical argument for *Ajayan* that he raised for *Tohji*. Office Action at 2. For similar reasons, this argument likewise fails.

With regard to *Ajayan*, Applicant respectfully points out that the authors are using multiwall carbon nanotubes dispersed in an epoxy matrix. *See Ajayan*, p. 1212, col. 3, ll. 7-8. These multiwall carbon nanotubes were “dispersed randomly in a liquid epoxide-base resin.” *See Ajayan*, p. 1212, col. 3, ll. 10-11. Furthermore, orientation of nanotubes occurs only during a cutting of a thin film of this material, wherein “[t]he directional cutting process creates shear that induces flow of material. The aligning here is similar to the aligning of rodlike dispersions in fluids during shear flow (13). The tubes that come into contact with the knife during cutting are

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<sup>1</sup> The holding in *In re Rose* is premised upon the Court of Custom and Patent Appeal's opinion in *In re Kirke*. *See In re Rose*, 220 F.2d at 463, 150 U.S.P.Q. at 240 citing *In re Yount*, 171 F.2d 317, 318, 80 U.S.P.Q. 1441, 143 (C.C.P.A. 1948), which in turn cited *In re Kirke*, 40 F.2d 765, 5 U.S.P.Q. 539, all of which when discussing the implications of a change of size or amounts for potential inventions.

pulled out or are deformed from the matrix and are oriented unidirectionally on the newly formed surface.” See *Ajayan*, page 1213, col. 3, ll. 5-13. Furthermore, “[i]t is difficult to unambiguously determine if the aligned tubes are present on the surface or embedded inside the films.” See *Ajayan*, page 1213, col. 2, ll. 15-17.

Regarding Claim 81, *Ajayan* does not teach single-wall carbon nanotubes. The nanotubes of *Ajayan* are multiwall carbon nanotubes, i.e. “Multishell carbon nanotubes” See *Ajayan*, p. 1212, col. 3, par. 1. Multiwall carbon nanotubes are significantly different than single-wall carbon nanotubes in many respects. Multiwall carbon nanotubes can be dispersed easily in common solvents and polymers, such as the epoxy matrix material of *Ajayan*, whereas single-wall carbon nanotubes, by their propensity to rope and be tightly held together by van der Waals forces, are difficult to disperse in most any solvent, matrix material or polymer. Multiwall carbon nanotubes are generally straight, stiff and rigid, whereas single-wall carbon nanotubes are flexible and can bend. Multiwall carbon nanotubes are prone to have defects in their carbon walls, whereas single-wall carbon nanotubes are generally defect-free. As a result of the generally, defect-free single-wall structure, single-wall carbon nanotubes are usually stronger, as well as more electrically and thermally conductive.

Furthermore, and as in *Tohji*, *Ajayan* does not teach or suggest a macroscopic nanotube array of at least about  $10^6$  single-wall carbon nanotubes in generally parallel orientation. The nanotubes of *Ajayan* are multiwalled and very few in number, i.e. much, much less than  $10^6$ . In order to analyze the nanotubes by microscopy, the nanotubes of *Ajayan* are of a microscopic quantity, few in number and generally well separated.

Additionally, the multiwall nanotubes of *Ajayan* are in or on a matrix material. The alignment of the multiwall nanotubes is a result of cutting the matrix material containing the randomly-oriented nanotubes. The stiffness of the multiwall nanotubes causes some of the multiwall nanotubes to be pulled and be aligned with the cutting blade. Those nanotubes that appeared to be pulled and aligned also appeared to adhere to the surface of the matrix. “Most tubes remained well attached to the films...suggesting that they adhered to the matrix phase.” See *Ajayan*, p. 1213, col. 2, par. 2.

Also, *Ajayan* does not teach or suggest a macroscopic molecular array of at least about  $10^6$  single-wall carbon nanotubes in generally parallel orientation. Only a small number of the multiwall nanotubes aligned in *Ajayan* were aligned. These aligned nanotubes were few in number and those that were aligned happened to be strategically oriented and situated in the matrix material such that they could align with a cutting blade as the matrix material was sliced.

*Ajayan* further does not teach or suggest nanotubes having substantially similar lengths in the range of from about 5 to about 500 nanometers. In the matrix material of *Ajayan*, the multiwall nanotubes of *Ajayan* are of various lengths. Furthermore, even the cutting process does not render them of substantially similar lengths. As one point, the multiwall nanotubes of *Ajayan*, do not appear to be cut in the process of slicing the matrix material. Even if the cutting process somehow cut the nanotubes, the nanotubes are randomly oriented, and not aligned, in the matrix material, such that any slice of material would not cut the nanotubes to have substantially similar lengths.

Because these elements are not disclosed in or taught by *Ajayan*, Claim 81 cannot be anticipated.

Regarding Claims 82-87, all of these claims are dependent upon Claim 81, and would not be anticipated for the same reasons that Claim 81 is not anticipated by *Ajayan*. Moreover, involve types of nanotubes, which *Ajayan* does not teach or suggest. Claim 86 includes the element of a substrate attached to the end of the molecular array of single-wall carbon nanotubes wherein the substrate is oriented substantially perpendicularly to the nanotubes in said array. In addition to the differences mentioned above, the aligned multiwall nanotubes of *Ajayan* are not perpendicular to the substrate, but rather parallel to the substrate, as the nanotubes are generally adhering to the surface of the matrix material at the cut edge.

Accordingly, Claims 82-87 are further not anticipated by *Ajayan*. Therefore, as a result of the foregoing, Applicant respectfully requests that the Examiner withdraw his rejection of Claims 81-87 under 35 U.S.C. § 102(a) as being anticipated by *Ajayan*.

**B. Obviousness**

Regarding obviousness, Examiner raises the identical argument for *Ajayan* that he raised for *Tohji*. Office Action at 2. Examiner has likewise failed to show any of these three basic criteria required to present its *prima facie* case of obviousness. (Again, Section II.A. above shows a number of elements not taught, disclosed, or suggested by *Ajayan*). And also, for the same reasons as discussed above in Section I.B., Examiner cannot overlook these deficiencies in the disclosure of *Ajayan* by misapplying the law in *In re Rose* 220 F.2d 459, 105 U.S.P.Q. 237.

Accordingly, Claims 81-87 are not obvious in view of *Tohji*. Therefore, as a result of the foregoing, Applicant respectfully requests that the Examiner withdraw his rejection of Claims 81-87 under 35 U.S.C. § 103(a) as being obvious over *Ajayan*.

**III. REJECTIONS UNDER 35 U.S.C. § 103(a) OVER AJAYAN**

Examiner has rejected Claims 104, 105, 111 and 112 under 35 U.S.C. § 103(a) as obvious over *Ajayan*. Office Action at 3. Applicant traverses these rejections.

With regard to Claims 104, 105, 111, and 112, all of the devices recited in these claims comprise the macroscopic molecular array claimed in Claim 81. For this reason alone these claims are nonobvious on the same grounds discussed above in Sections I.B. & II.

In addition, Examiner contends “The reference does not teach the ... uses, however these are obvious as means to exploit the well-established emitter and electronic properties of carbon nanotubes. The Examiner takes Official Notice that the non-nanotube structures recited in the claims are old and known.” Office Action at 3. Applicant traverses such Official Notice as it suggests, without support, that it would have been obvious to combine the non-nanotube structures recited in the claim with a macroscopic molecular array of single-wall carbon nanotubes to form the patented invention, without any basis underlying such suggestion to combine.

Regarding Claims 104 and dependent claim 105 directed to a solar cell, these claims include the element of Claim 81, *i.e.*, a molecular array comprising at least about  $10^6$  single-wall carbon nanotubes in generally parallel orientation and having substantially similar lengths in the

range of from about 5 to about 500 nanometers. Thus, Claims 104 and 105 are not obvious over *Ajayan* for the same reasons that Claim 81 is not obvious over *Ajayan*. Moreover, there is no teaching or suggestion in *Ajayan* with respect to a solar cell for converting broad spectrum light energy into electrical current or to a photon collector, as presented in Claim 104, or to a photoactive dye coupled to the upper ends of the nanotubes in said array, as presented in Claim 105.

Regarding Claim 111 directed to a microporous anode, this claim includes the element of Claim 81, i.e., a molecular array comprising at least about  $10^6$  single-wall carbon nanotubes in generally parallel orientation and having substantially similar lengths in the range of from about 5 to about 500 nanometers. Thus, Claim 111 is not obvious over *Ajayan* for the same reasons that Claim 81 is not obvious over *Ajayan*. Furthermore, there is no teaching or suggestion in *Ajayan* with respect to a microporous anode for an electrochemical cell, as presented in Claim 111.

Regarding Claim 112 directed to a lithium ion battery, this claim includes the element of Claim 81, i.e., a molecular array comprising at least about  $10^6$  single-wall carbon nanotubes in generally parallel orientation and having substantially similar lengths in the range of from about 5 to about 500 nanometers. Thus, Claim 112 is not obvious over *Ajayan* for the same reasons that Claim 81 is not obvious over *Ajayan*. Furthermore, there is no teaching or suggestion in *Ajayan* with respect to a lithium ion secondary battery comprising an anode, a cathode comprising  $\text{LiCoO}_2$  and an aprotic organic electrolyte, a fullerene intercalating compound of lithium forms at the anode under charging conditions, wherein the anode comprises the molecular array, as presented in Claim 112.

Therefore, as a result of the foregoing, Applicant respectfully notes that a *prima facie* case of obviousness has not been established, and respectfully requests that the Examiner withdraw his rejection of Claims 104, 105, 111 and 112 under 35 U.S.C. § 103(a) as being obvious over *Ajayan*.



**IV. CLAIMS OBJECTED TO**

Examiner has objected to Claims 88-90. The reasons for the objections were not given, however, it is expected that the objections are due to the claims being dependent upon a rejected claim. However, in view of the arguments raised above for Claims 81 and 86-87 (from which Claims 88-90 depend directly or indirectly from), Applicant respectfully requests that the Examiner withdraw his objection of Claims 88-90.

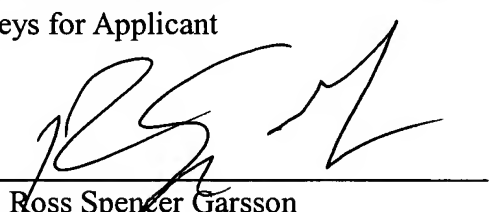
**IV. CONCLUSION**

As a result of the foregoing, it is asserted by Applicant that the Claims in the Application are now in a condition for allowance, and respectfully request allowance of such Claims.

Applicant respectfully requests that the Examiner call Applicant's attorney at the below listed number if the Examiner believes that such a discussion would be helpful in resolving any remaining problems.

Respectfully submitted,

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